

REMARKS

Claims 26 and 32-35 are being canceled and claims 1, 18 and 25 amended in response to the rejections herein under 35 U.S.C. §§112, 102 and 103. The dependencies of claims 18-24 and 26-31 are being corrected, and new claims 36-39 are being added to cover certain particularly preferred embodiments of the invention. Reconsideration of this application in view of these amendments and the following remarks is respectfully requested.

The Examiner required restriction as between Group I claims 1-31 drawn to a process and Group II claims 32-35 drawn to a catalyst. Applicants confirm their election of Group I claims 1-31 for further prosecution in this application. Claims 32-35 are being canceled without prejudice to Applicants' right to pursue those claims in one or more continuing applications.

The Examiner rejected claims 1-31 under 35 U.S.C. §112 as indefinite for failing to particularly point out the invention. Claims 1, 18 and 25 were found unclear for lack of a specific recitation as to the results of carrying out the claimed process. In response to that rejection, Applicants have amended claims 1, 18 and 25 based on original disclosure at page 1, line 21 to page 2, line 5 and page 17, line 13 to page 18, line 7 of the specification. Thus the rejected claims now expressly recite the results inherently flowing from the claimed process steps.

The Examiner found claims 5, 6 and 21 to be indefinite with regard to the limitation "said hydrotreating catalyst components" on the ground of lack of antecedent basis. Claims 5 and 6 depend from claim 1, claim 1 expressly reciting a process step (b) consisting of "passing said feed stream over a monolithic catalyst bed containing hydrotreating catalyst components"... Claim 21 depends from claim 18, claim 18 expressly reciting a step (b) consisting of "passing said feed stream over a monolithic catalyst bed containing hydrotreating catalyst components"... In both instances, therefore, it appears that express basis for the limitations objected to is found in the base claim from which the rejected claims depend. Accordingly, this rejection is believed to be in error, and

reconsideration and withdrawal thereof are respectfully requested. In the event that the Applicants have simply misapprehended the basis for the rejection, clarification thereof is courteously requested.

Finally, the Examiner rejected claim 18 on the ground of lack of antecedent basis for the limitations "the treated hydrocarbon effluent" and "the sour gas" in line 6. In response to that rejection, claim 18 has been amended to introduce proper antecedent basis for the objectionable limitations.

For the foregoing reasons and light of the submitted amendments, the Applicants respectfully submit that the remaining claims as amended are now in full compliance with 35 U.S.C. §112. Accordingly reconsideration and withdrawal of the claims rejections on formal grounds are respectfully requested.

The Examiner next objected to the Information Disclosure Statements on the ground that (i) pages were missing from Reference AS filed October 4, 2001, (ii) Reference AV cited October 4, 2001 was not included in the submission, and (iii) Reference AV cited December 31, 2001 was not included in the submission.

In response to those objections the Applicants submit herewith fresh copies of each of the references cited. It appears from the record that the Applicants have made a bona fide attempt to comply with 37 CFR §1.98 in this case, but inadvertently may have omitted part of the required content from the previously filed Disclosure Statements.

37 CFR §1.97(f) empowers the Examiner to grant additional time for full compliance in such cases, and such grant of additional time is respectfully requested. However, in the event the Examiner is unwilling to grant such additional time, and a fee under 37 CFR §1.17(p) for the submission is therefore deemed to be due, the Office is hereby authorized to charge that fee to the deposit account of Corning Incorporated, Customer No. 22928, Deposit Account No. 03-3325.

Turning next to the art rejections, the Examiner has rejected claims 1-10, 14 and 15 of the application as being anticipated by A. Cybulski and K.A. Moulijn, "Monoliths in Heterogeneous Catalysis", Catal.Rev.-Sci.Eng., **36**(2), 179-270

(1994). That reference, hereinafter referred to as "Cybulski", corresponds to Reference AS cited by Applicants on October 4, 2001.

The Examiner characterized Cybulski as disclosing a hydrodesulfurization process using an alumina, Co and Mo monolithic catalyst at a superficial liquid velocity, pressure, and temperature within the ranges of the rejected claims. Recognizing the the failure of Cybulski to show a one-pass conversion greater than 50%, the Examiner nevertheless held that claim limitation to be inherent in the Cybulski disclosure.

This rejection is respectfully traversed for the following reasons. First Cybulski does not in fact disclose a hydrodesulfurization or other heteroatom removal process employing the set of parameters identified by the Examiner or by the Applicants. To the contrary, no specific parameter set that would be operative for a high-yield, one-pass conversion process are disclosed.

Cybulski does refer to prior literature reporting on the use of alumina-Co-Mo catalysts for desulfurization at temperatures in the 500-650°C range (page 201), but that disclosure relates to previously investigated temperatures and pressures only. No flow rates or conversion efficiencies are given.

In his general summary of monolith possibilities for all gas-liquid processing, Cybulski provides a table of the ranges of gas and liquid flow that would be useful to maintain Taylor flow in monolith channels in gas/liquid treatment processes (pages 254-255). This disclosure is not given with reference to any particular process, and particularly not with reference to hydrodesulfurization processes, but relates instead to flow parameters for maintaining Taylor flow in monoliths.

The fact that this disclosure is not relevant to the Applicants' heteroatom removal process is indicated by the fact that the Applicants can achieve excellent results under flow parameters that develop film flow conditions (page 4, lines 25-31 of the specification). This is a type of flow that Cybulski expressly states should be avoided, because it results in pulsating liquid flow with poor mass transfer and residence time characteristics (Cybulski, page 242).

In further support of this rejection the Examiner has suggested that conversion rates of 50% per pass would be inherent in Cybulski from the similarity of process conditions cited. However, the Irandoust publication cited by Cybulski (also cited by the Applicants as reference AV on October 4, 2001), appears to require several hours and multiple passes through the test reactor to achieve 50% desulfurization of a thiophene-containing test feed (Fig. 6 at page 751 of the publication). Accordingly there appears to be no basis in the record as a whole for a finding of inherent anticipation by Cybulski.

In summary, the Applicants respectfully submit that there is no disclosure or suggestion in Cybulski of any specific hydrodesulfurization process parameters that would effect desulfurization of a liquid fuel stream at more than 50% per pass. Nor is any data provided that would create a reasonable expectation in those of ordinary skill in these arts that a hydrodesulfurization process over a monolith catalyst could achieve such results.

Turning next to the rejections herein under 35 U.S.C. §103, the Examiner has rejected claims 11-13 on Cybulski on the ground that it would have been obvious to modify the process of Cybulski to use feeds other than those taught in the reference. This rejection is respectfully traversed. To the contrary, even a cursory review of Cybulski indicates that the effectiveness of monolith reactors varies widely depending on the particular process and process flow conditions being studied, a fact that the authors themselves acknowledge (Cybulski, pages 255-256).

As a specific example, the Soni reference cited by Cybulski at pages 222-223 (and by the Applicants at page 2 of the specification) suggests that substantial differences in laboratory test results have been observed where oil feedstocks of differing boiling range and composition have been tested. This is a clear indication that results can vary markedly with feedstock selection, and it suggests an awareness in the art that not any hydrocarbon feed can be processed with useful results in any process. In particular, it is not obvious that the specific feedstocks mentioned in the dependent claims may be processed

with high single-pass efficiencies within the process parameters of the independent claims.

The Examiner next rejected claims 16, 17, 22, 23, 25 and 28 on reference to Cybulski on the ground that it would have been obvious to modify the process of Cybulski to use the claimed ratio of hydrogen, or any ratio of hydrogen greater than the stoichiometric amount. This conclusion is traversed because Cybulski expressly teaches that gas volumes in monolith reactors must be restricted to volumes that will meet Taylor flow requirements (Cybulski, page 254). Further, the use of stoichiometric amounts of gas are not required in differential reactors of the kinds shown in the literature, since the recycling of unreacted hydrogen, supplemented with hydrogen additions as needed, is a conventional feature assuring adequate hydrogen supply whether or not stoichiometric amounts are used.

The Examiner has specifically characterized the Applicants' use of an LHSV greater than 0.1 hr^{-1} as an obvious process limitation aimed merely at optimizing process results. The use of a specific space velocity parameter in accordance with the rejected claims represents a preferred condition for securing high single-pass conversions in accordance with the Applicants' basic method. Since that basic method is not disclosed in the cited reference, there can be no suggestion to modify the space velocity employed in the basic method to secure a higher conversion rate. Stated differently, there is nothing in the reference to suggest whether a space velocity above 0.1 hr^{-1} or below 0.1 hr^{-1} would be useful in a hydrodesulfurization process in accordance with the Applicants' invention. Therefore, the Applicants respectfully submit that the use of the claimed space velocity in that process cannot be obvious.

For all of the above reasons, it is respectfully submitted that claims 16, 17, 22, 23, 25 and 28 are not obvious from the disclosure of Cybulski under 35 U.S.C. §103. Accordingly, reconsideration and withdrawal of the rejection of those claims are respectfully requested.

Finally, the Examiner has rejected claim 18 of the application under 35 U.S.C. §103 on the ground that the used of a feed containing less than 3% sulfur

would be obvious from Cybulski. Reconsideration and withdrawal of this rejection is respectfully requested for the reason that Cybulski's failure to speak to the issue of maximum sulfur content does not make all such limitations obvious. Clearly, there is no teaching in Cybulski that sulfur level is immaterial to the efficiency of a hydrodesulfurization process. And, as the Examiner will no doubt recognize, the use of a feedstock containing very large sulfur concentrations might well make the goal of 90% sulfur removal in a single sulfur removal pass difficult or impossible to achieve. The Applicants' one-pass conversion processes are most effective at sulfur concentrations of 3% and below, but there is clearly nothing in Cybulski to suggest that result.

To more particularly point out certain of the Applicants' particularly preferred processes, additional claims 36-39 have been added to the application. Basis for the new claims is found at page 8, lines 9028 and page 17, lines 20-22 of the applications filed. Favorable consideration of these additional claims on the basis of the foregoing comments is also respectfully requested.

For all of the above reasons, the Applicants respectfully submit that the remaining claims of this application as amended are now in full compliance with 35 U.S.C. §112 and patentable over the art of record in this case. Accordingly, favorable reconsideration of this application and allowance of those remaining claims are courteously solicited.

Pursuant to 37 C.F.R. § 1.136(a), the Applicants respectfully request a one (1) month extension of the time period in which to file this response. The Applicants believe that, with such extension this response is timely. However, in the event of error the Office is requested to grant such additional time extensions as may be required to make this response timely, and is hereby authorized to

charge any fee or surcharge with respect to said time extensions to the deposit account of Corning Incorporated, Deposit Account 03-3325.

Respectfully submitted,

A handwritten signature in cursive script, appearing to read 'Kees van der Sterre', written over a horizontal line.

DATE: January 27, 2003

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

1. A method for hydrotreating hydrocarbons to remove heteroatoms therefrom comprising:
 - a. combining hydrogen-containing gas with a liquid hydrocarbon stream containing sulfur, nitrogen, metal or oxygen heteroatoms to form a feed stream;
 - b. passing said feed stream over a monolithic catalyst bed containing hydrotreating catalyst components to remove the heteroatoms therefrom;
 - c. wherein the superficial liquid linear velocity of said feed stream is greater than about 0.02 cm/s and the one-pass conversion of a heteroatom is greater than 50%.

18. A method for making low-sulfur diesel fuel comprising:
 - a. combining hydrogen-containing gas with a liquid hydrocarbon stream containing less than 3 wt % sulfur as organic sulfur compounds to form a feed stream;
 - b. passing said feed stream over a monolithic catalyst bed containing hydrotreating catalyst components to convert organic sulfur compounds to hydrogen sulfide and produce a treated hydrocarbon effluent;
 - c. separating the treated hydrocarbon effluent from ~~the~~ a sour gas containing the hydrogen sulfide,
 - d. wherein the separated, treated liquid hydrocarbon is a diesel fuel ~~containing~~ contains less than about 5000 wppm sulfur.

19. The method for making low-sulfur diesel fuel as described in claim ~~13~~18, wherein said diesel fuel product contains less than about 15 wppm sulfur.

20. The method for making low-sulfur diesel fuel as described in claim ~~13~~18, wherein said monolithic catalyst bed has a honeycomb configuration.

21. The method for making low-sulfur diesel fuel as described in claim 4318, wherein said hydrotreating catalyst components are from the group of cobalt, molybdenum, nickel, tungsten, and phosphorous.

22. The method for making low-sulfur diesel fuel as described in claim 4318, wherein the superficial liquid linear velocity is greater than about 0.02 cm/s, the feed hydrogen gas to liquid feed volume ratio is greater than about 10 NL/L, the liquid hourly space velocity is greater than about 0.1 h^{-1} , the reactor pressure is greater than about 1 bar, and the reaction temperature is greater than about 200°C .

23. The method for making low-sulfur diesel fuel as described in claim 4722, wherein the feed hydrogen gas to liquid feed volume ratio is greater than about 50 NL/L, the liquid hourly space velocity is greater than about 0.7 h^{-1} , the reactor pressure is greater than about 20 bar, and the reaction temperature is greater than about 250°C .

24. The method for making low-sulfur diesel fuel as described in claim 4722, wherein the superficial liquid linear velocity is greater than about 0.2 cm/s.

25. A method for increasing one-pass heteroatom conversion in a hydrotreating reactor while maintaining hydrotreating selectivity, comprising:

- a. combining hydrogen-containing gas with a liquid hydrocarbon stream containing sulfur, nitrogen, metal or oxygen heteroatoms to form a feed stream;
- b. passing said feed stream over a monolithic honeycomb catalyst bed containing hydrotreating catalyst components to react the heteroatoms with hydrogen;
- c. said monolithic honeycomb catalyst bed having a cell density greater than about 10 cpsi and channel opening diameters greater than about 0.1 mm;
- d. wherein the superficial liquid linear velocity of said feed stream is greater than about 0.02 cm/s, the feed hydrogen gas to liquid feed volume ratio is greater than about 10 NL/L, the liquid hourly space velocity is greater than about 0.1 h^{-1} , the reactor pressure is greater than about 1 bar, and the reaction temperature is greater than about 200°C ;

e. and wherein the one-pass conversion of the targeted heteroatom is greater than 50% with comparable product and feed distillation points.

26. The method for increasing one-pass heteroatom conversion in a hydrotreating reactor while maintaining hydrotreating selectivity as described in claim 2025, wherein said heteroatoms are from a group consisting of sulfur, nitrogen, metals, and oxygen.

27. The method for increasing one-pass heteroatom conversion in a hydrotreating reactor while maintaining hydrotreating selectivity as described in claim 2025, wherein the superficial liquid linear velocity is greater than about 0.2 cm/s.

28. The method for increasing one-pass heteroatom conversion in a hydrotreating reactor while maintaining hydrotreating selectivity as described in claim 2025, wherein the feed hydrogen gas to liquid feed volume ratio is greater than about 50 NL/L, the liquid hourly space velocity is greater than about 0.7 h^{-1} , the reactor pressure is greater than about 20 bar, and the reaction temperature is greater than about 250°C .

29. The method for increasing one-pass heteroatom conversion in a hydrotreating reactor while maintaining hydrotreating selectivity as described in claim 2025, wherein at least 70% (vol.) of the product stream has a D86 distillation temperature range falling within the D86 distillation range of the feedstock.

30. The method for increasing one-pass heteroatom conversion in a hydrotreating reactor while maintaining hydrotreating selectivity as described in claim 2025, wherein said one-pass conversion of the targeted heteroatom is greater than 80%.

31. The method for increasing one-pass heteroatom conversion in a hydrotreating reactor while maintaining hydrotreating selectivity as described in claim 2025, wherein said one-pass conversion of the targeted heteroatom is greater than 90%.